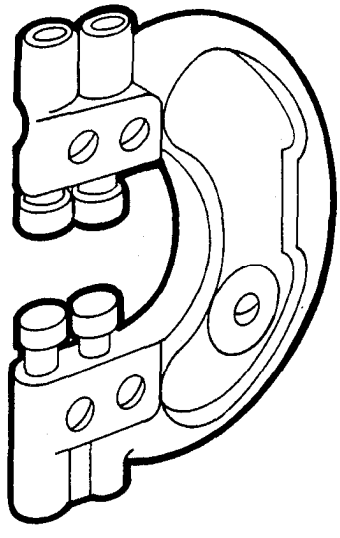
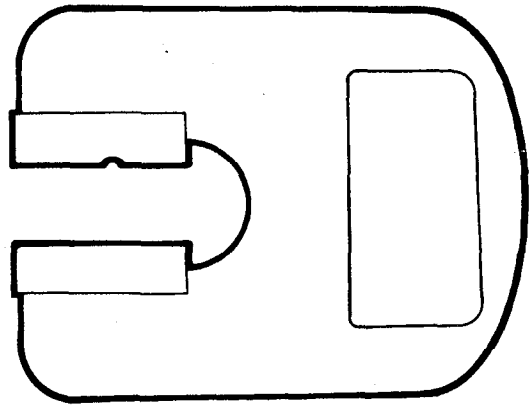
Chapter 15 RING AND SNAP GAGES AND GAGE BLOCKS

HOW TO CHOOSE AND USE THEM

The "Types and Uses" section provides you with a list of the types of gages. These pages should help you select the right gage for the job.

The "Using" section tells you how to use the gages to make a measurement. The "Care" procedures tell you how to care for the gages.





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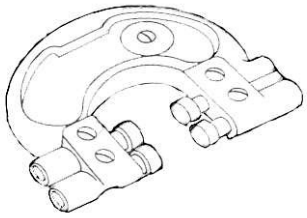
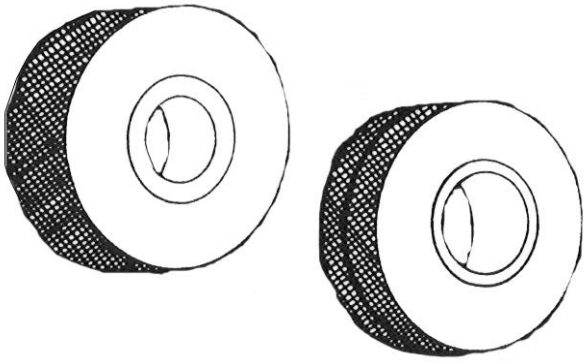
TYPES AND USES

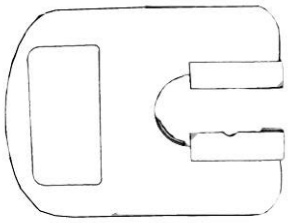
Ring and snap gages and precision gage blocks are used as standards to determine whether or not one or more dimensions of a manufactured post are within specified limits. Their measurements are included in the construction of each gage, and they are called fixed gages. However, some snap gages are adjustable. Gages are used for a wide range of work, from rough machining to the finest tool and die making. The accuracy required of the same type of gage will be different, depending on the use.



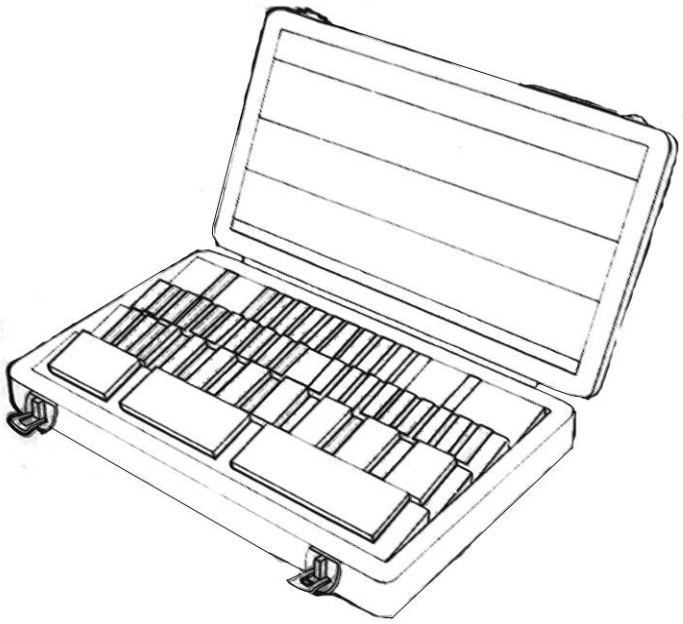
SNAP GAGE - ADJUSTABLE



RING GAGES



SNAP GAGE - NONADJUSTABLE



GAGE BLOCKS

The following classes of gages and their limits of accuracy are standard for all makes:

Class X - Precision lapped to close tolerances for many types of masters and the highest quality working and inspection gages.

Class Y - Good lapped finish to slightly increased tolerances for inspection and working gages.

Class Z - Commercial finish (ground and polished, but not fully lapped) for a large percentage of working gages in which tolerances are fairly wide, and where production quantities are not so large.

Class ZZ - (Ring gages only). Ground only to meet the demand for an inexpensive gage, where quantities are small and tolerances liberal.

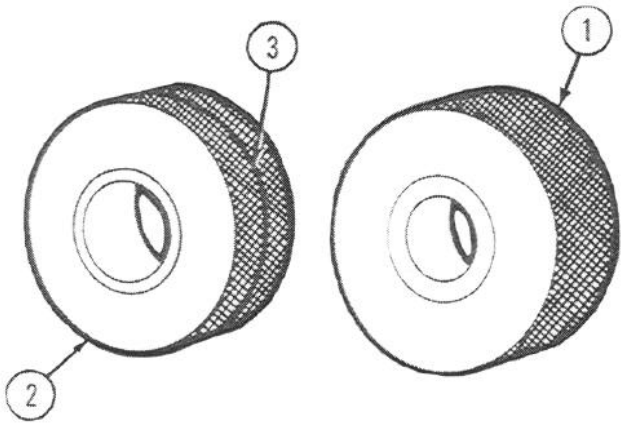
The table below lists the tolerances for ring gages in each class:

ABOVE	TO AND INCL	X	Y	Z	RING GAGES ZZ
0.029	0.825	0.00004	0.00007	0.00010	0.00020
0.825	1.510	0.00006	0.00009	0.00012	0.00024
1.510	2.510	0.00008	0.00012	0.00016	0.00032
2.510	4.510	0.00010	0.00015	0.00020	0.00040
4.510	6.510	0.00013	0.00019	0.00025	0.00050
6.510	9.010	0.00016	0.00024	0.00032	0.00064
9.010	12.010	0.00020	0.00030	0.00040	0.00080

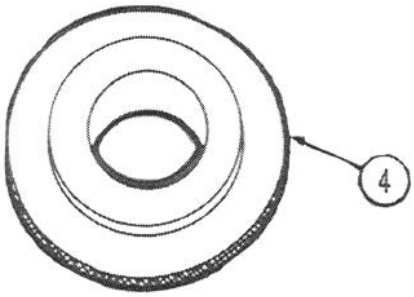
X Precision lapped
Y Lapped
Z Ground or polished (grinding marks may be in evidence),
ZZ Ground only

TYPES AND USES

RING GAGES

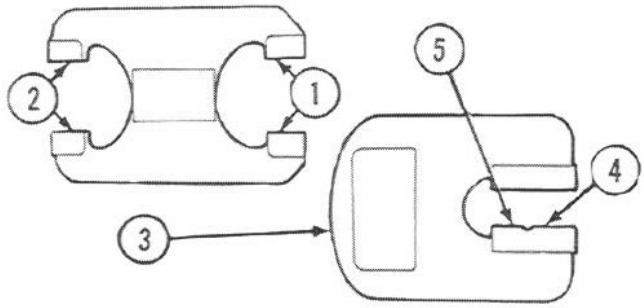


The plain ring gage is an external gage of circular form. For sizes between 0.059 and 0.510 inch, ring gages are made with a hardened bushing pressed into a soft body. The thickness of the gage will range from 3/16 to 1-5/16 inches. On ring gages, the GO gage (1) is larger than the NO GO gage (2). The GO and NO GO ring gages are separate units. They can be distinguished from each other by an annular groove (3) cut in the knurled outer surface of the NO GO gage. Ring gages made for diameters of 0.510 to 1.510 inches are the same as those shown above, except there is no bushing; they are made all in one piece. Ring gages, sized from 1.510 to 5.510 inches are made with a flange (4). This design reduces the weight, making the larger sizes easier to handle.



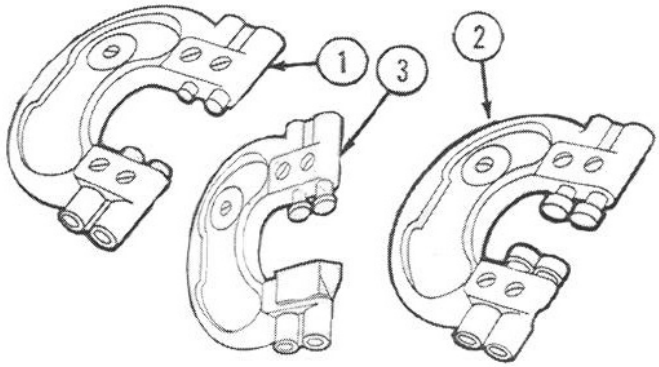
Ring gages are used more often in the inspection of finished parts than parts in process. The reason for this is that the finished parts are usually readily accessible; whereas, parts in a machine that are supported at both ends would have to be removed to be checked.

SNAP GAGES



The plain snap gage is made in two general types, the nonadjustable and adjustable.

The nonadjustable type is a solid construction, having two gaging members, GO (1) and NO GO (2) as shown above. The part to be inspected is first tried on the GO side and then the gage is reversed and the part tried on the NO GO side. Some solid snap gages (3) have combined gaging members in the same set of jaws as shown above, known as a progressive snap gage. The outer member (4) gages the GO dimension and the inner member (5) the NO GO dimension.



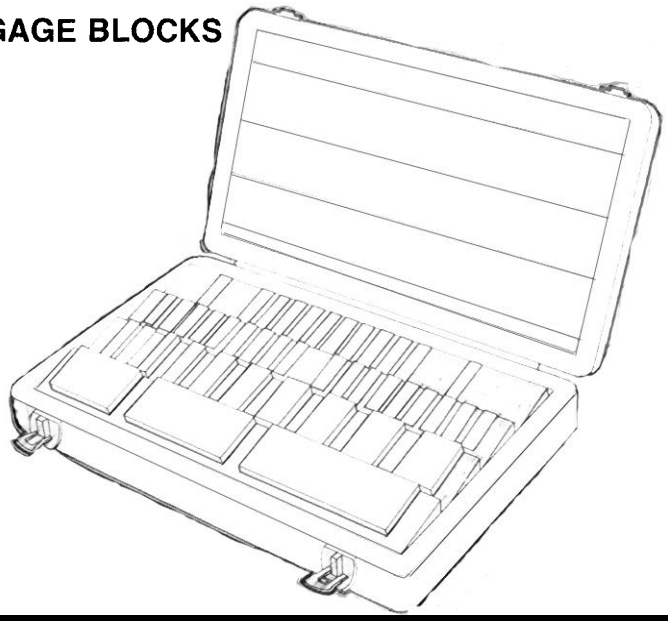
Three standard designs of the adjustable type are available, consisting of a light, rigid frame with adjustable gaging pins, buttons, or anvils. These pins or buttons may be securely locked in place after adjustment, and locking screws are tightened to hold the gaging dimensions.

One type of adjustable snap gage is made in sizes that range from 1/2 to 12 inches (1). It is equipped with four gaging pins and is suitable for checking the dimension between surfaces. Another type is made in sizes that range from 1/2 to 11-1/4 inches (2). It is equipped with four gaging buttons and is suitable for checking flat or cylindrical work.

The third type is made in sizes from 1/2 to 11-5/8 inches (3). It is equipped with two gaging buttons and a single block anvil, and is especially suitable for checking the diameters of shafts, pins, studs, and hubs.

TYPES AND USES - Continued

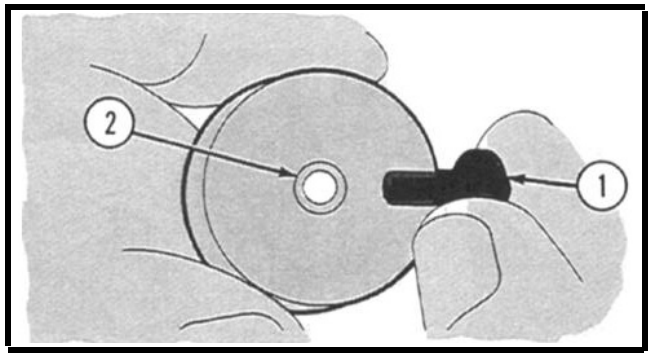
GAGE BLOCKS



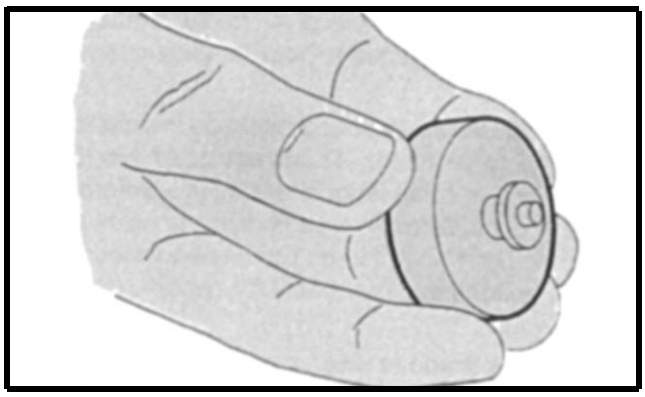
Gage blocks are available in sets of from 5 to as many as 85 blocks of different dimensions. Precision gage blocks are made from a special alloy steel. They are hardened, ground, and then stabilized over a period of time to reduce subsequent waxing. They are rectangular in shape with measuring surfaces on opposite sides. The measuring surfaces are lapped and polished to an optically flat surface and the distance between them is the measuring dimension. This dimension may range from 0.010 inch up to 20 inches.

USING A RING GAGE

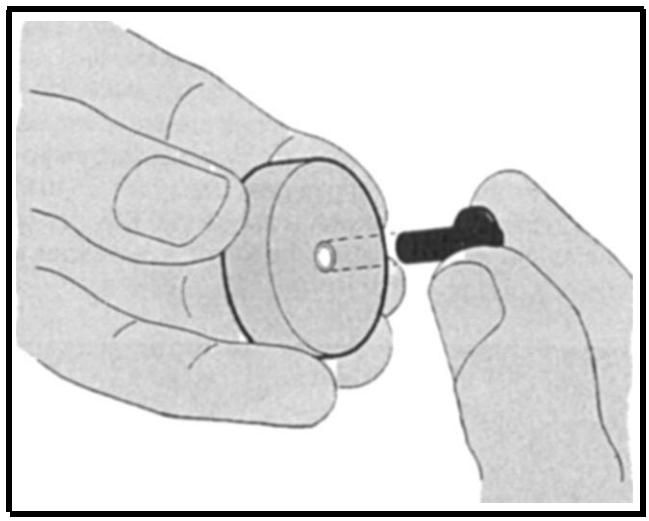
To check the shank diameter of a pivot stud.



1 Line the stud (1) up with the hole (2) and press in gently. If the stud will not go in, the shank is too large. If it will go in, the stud is not oversize.



2 With the stud in the hole, check the piece for taper and out-of-roundness by sensing any wobble.



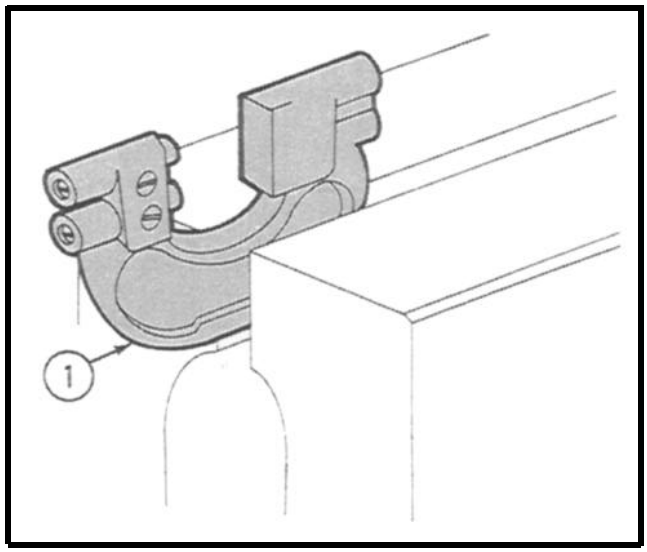
3 After checking the part in the GO gage, check it in the NO GO gage. The stud must not enter this gage to establish it as being between the desired limits.

NOTE

The GO ring gage controls the maximum dimension of a part and NO GO plug gages control the minimum dimension of a hole. Therefore, GO gages control the tightness of fit of mating parts and NO GO gages control the looseness of fit of mating parts.

USING AN ADJUSTABLE SNAP GAGE

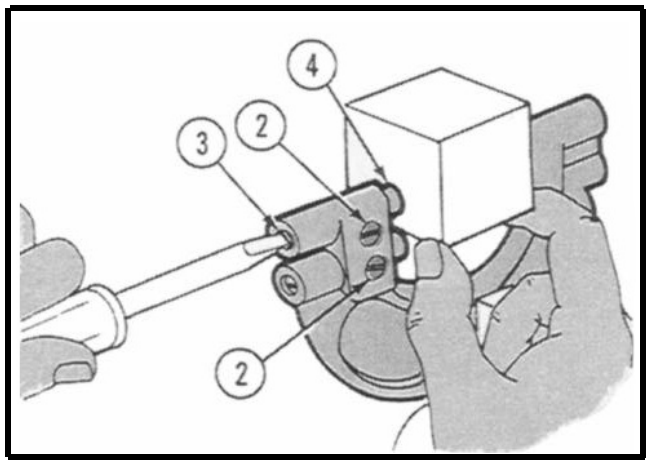
Before an adjustable snap gage can be used to check parts, the GO and NO GO buttons, pins, or anvils must be set to the proper dimensions.



1 The snap (1) gage must first be clamped in a holder.

NOTE

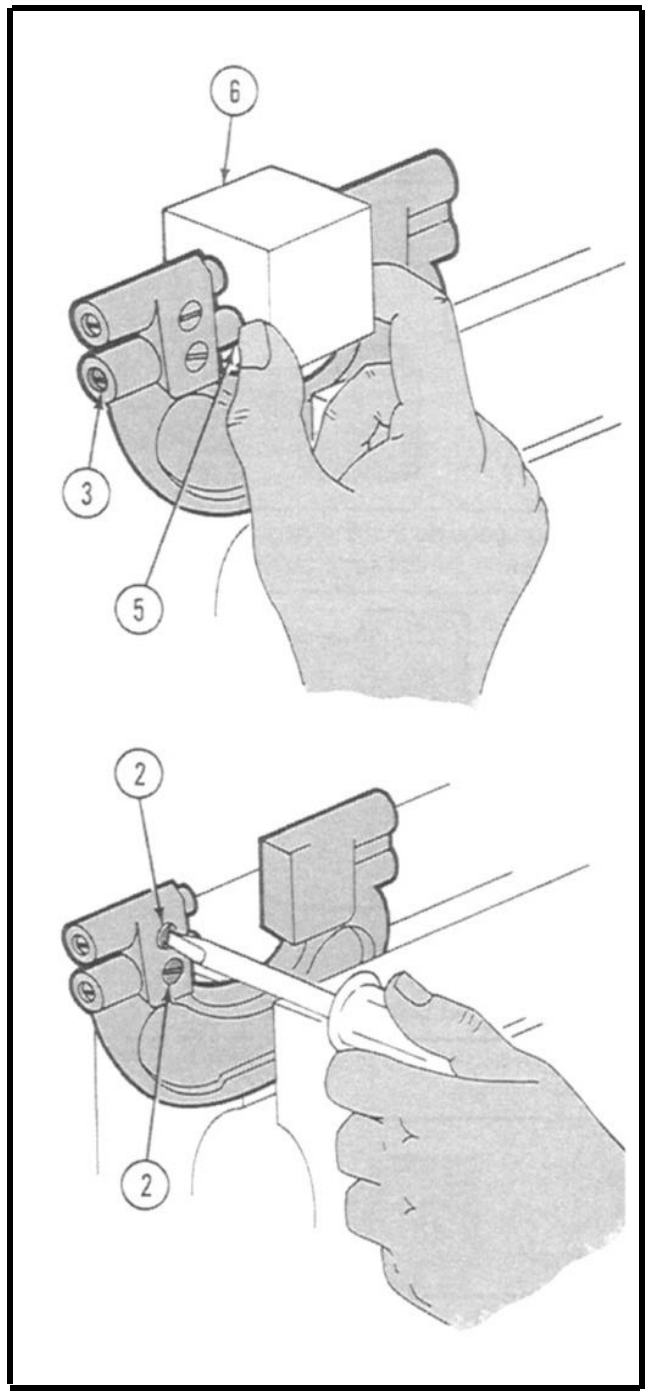
Adjust the "GO" dimension first as shown in the illustration, or if desired, reverse the procedure and adjust the "NO GO" dimension first.



2 Loosen the locking screw (2) and turn the adjusting screws (3) until the dimensions (4) is set.

NOTE

The desired dimension may be taken from a master disk, a precision gage block, or a master plug.



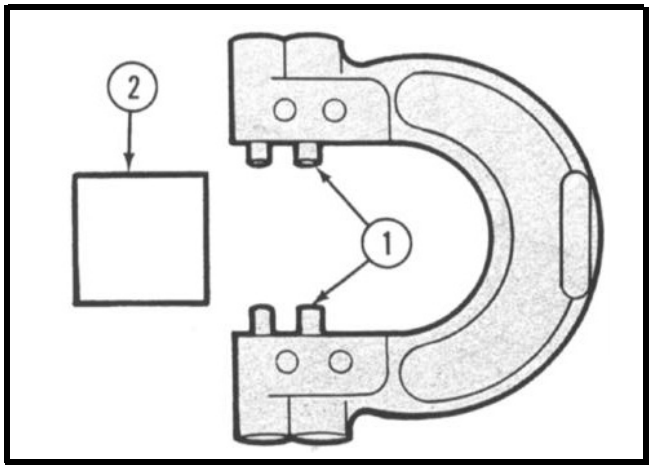
3 Turn the other adjusting screw (3) until the "NO GO" dimension (5) is set.

4 After adjusting for proper dimensions with the master precision piece (6) in place, tighten the locking screws (2).

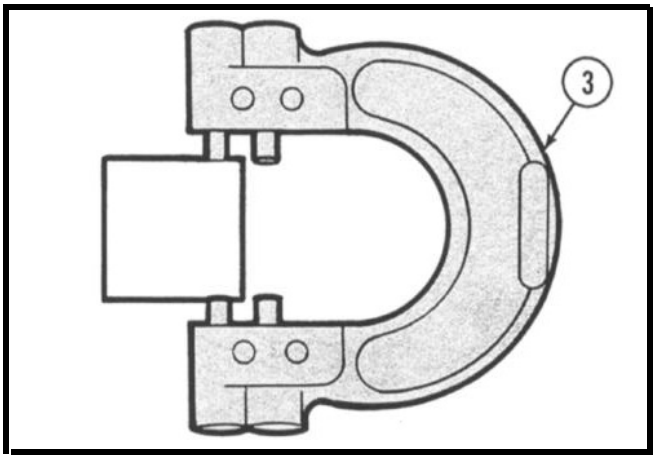
5 Recheck to make sure the dimensions have not changed before using the gage.

USING AN ADJUSTABLE SNAP GAGE - Continued

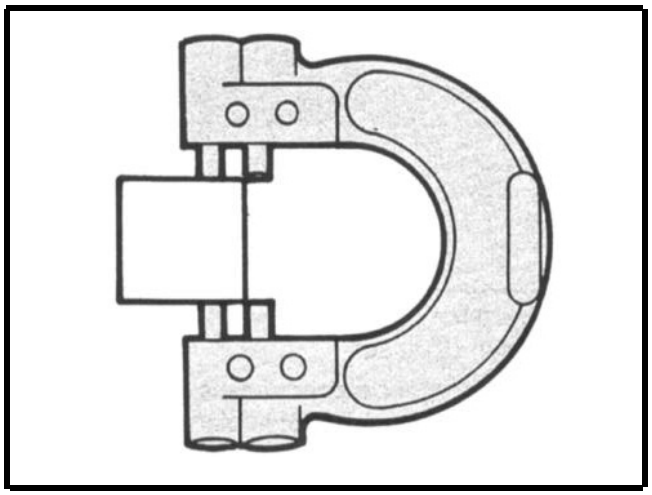
GAGING FLAT PARTS



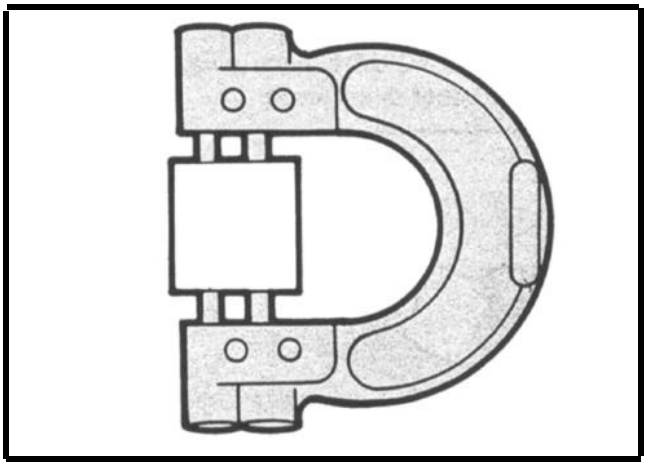
1 Position gage so that the pins or buttons (1) are square with the flat surfaces on the part (2).



2 Using a slight hand pressure, push the gage (3) over the part.

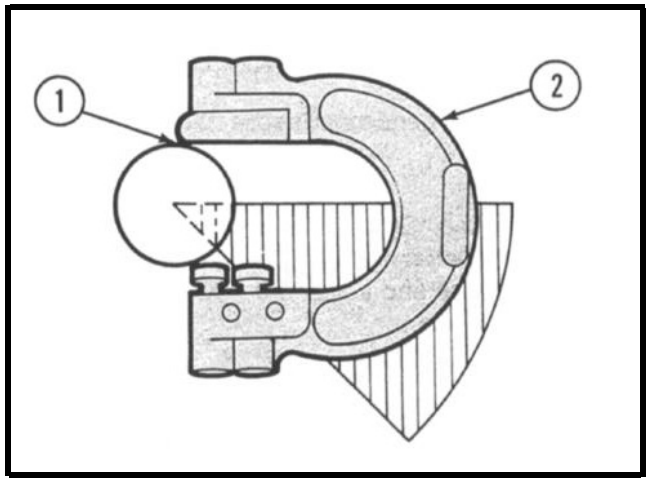


3 If the part is within limits, the NO GO pins will stop the part.

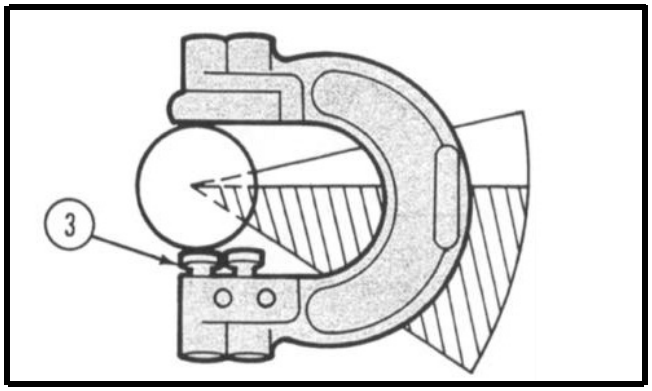


4 If the part is undersize, it will be possible to push it past the NO GO pins.

GAGING CYLINDRICAL PARTS

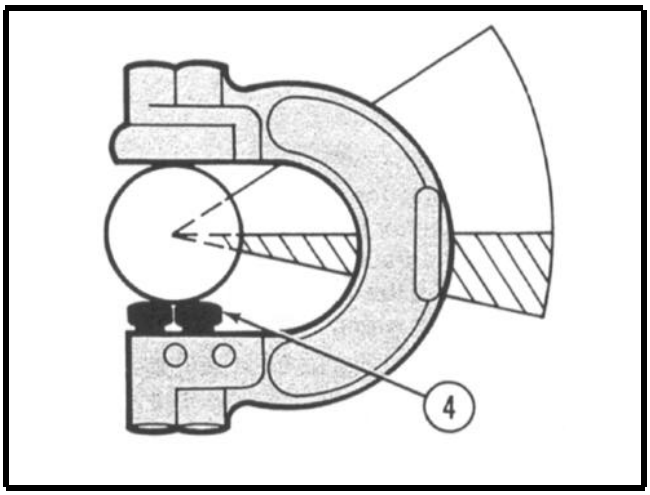


1 Locate the gage on the part with the solid anvil (1) on top. Rock the gage (2) as indicated by the shaded segment above, where the GO dimension is checked.

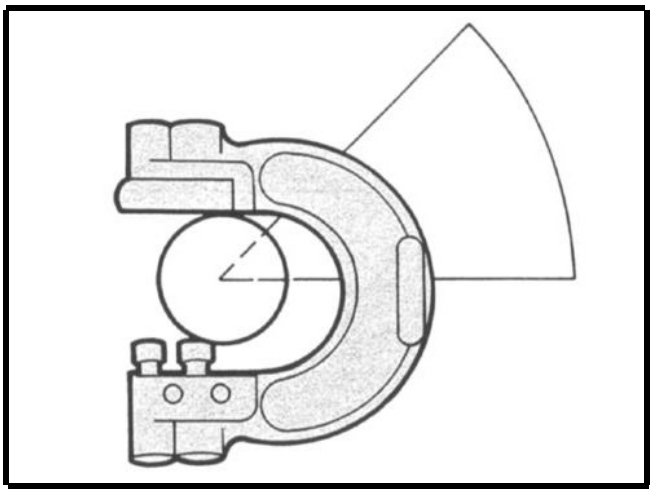


2 If the shaft is not oversized, the first button (3) will pass over it easily.

USING AN ADJUSTABLE SNAP GAGE - Continued



3 Move the gage to the position shown above. If the NO GO button (4) stops the gage, the shaft is within limits.



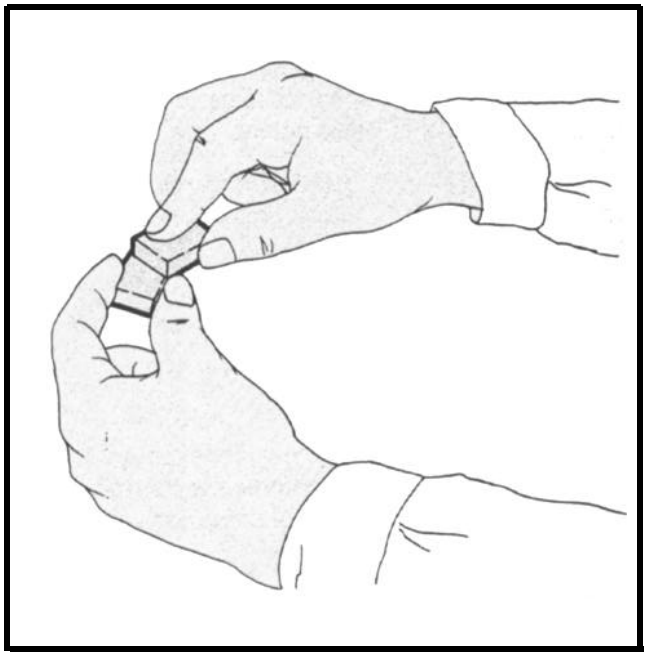
4 If the gage can be rocked further to the position, as shown, the part diameter is too small, since it has passed the NO GO button.

HOW TO USE PRECISION GAGE BLOCKS

Before using gage blocks, remove the coat of rust-preventive compound with a chamois or a piece of cleansing tissue or by cleaning with an approved solvent. Gage blocks and any measuring tool used with them must be free of grease, oil, dirt, and other foreign matter to avoid a lapping action whenever the block is moved, and to ensure accurate measurement. When using gage blocks, take particular care when measuring hardened work to avoid scratching the measuring surfaces.

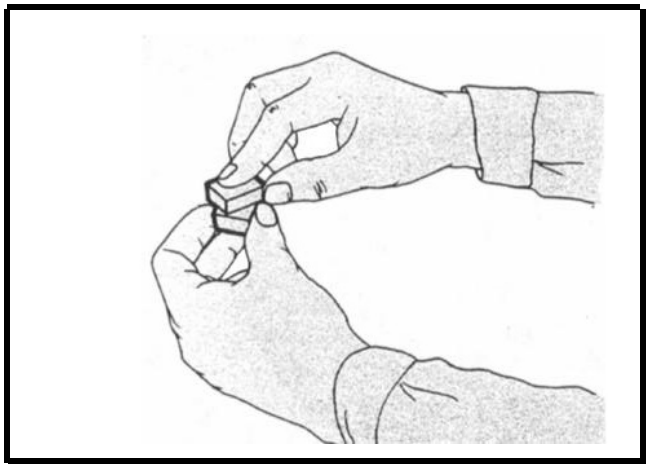
NOTE

When building gage blocks (wringing them together) to obtain a desired dimension, care should be exercised to avoid damaging them.



1 Bring the blocks together flat and move them slightly back and forth. This minimizes scratching, as it will detect any foreign particles between the surfaces.

USING PRECISION GAGE BLOCKS - Continued



2 Shift the blocks. If the blocks are clean, they will begin to take hold.

3 Slide the two blocks together, using a slight pressure and a rotary motion.

4 Shift gage blocks so that their sides are in line. Any combination of gage blocks may be stacked together in this manner. The combination will be as solid as a single block.

NOTE

The adhesive force that binds two gage blocks together is a combination of molecular attraction and the suction cup action due to the film of oil or moisture on the surfaces wrung together.

Separate gage blocks by sliding them apart, using the same movement as when wringing them together.

CAUTION

Do not leave blocks wrung together for long periods of time since surfaces in contact will tend to corrode.

FACTORS TO CONSIDER WHEN USING GAGE BLOCKS

Ordinary changes in temperature have a sizable effect on measurements made with precision gage blocks. The standard measuring temperature is 68°F, which is just a little lower than the average temperature in most shops. Since the room temperature affects the work as well as the block, the expansion in the work will be matched in most cases by a similar expansion in the block. The coefficient of linear expansion of several metals and blocks is listed below:

Material	*Millionths of an inch*
Steel	5.5 to 7.2 per degree F
Iron	5.5 to 6.7
Phosphor bronze	9.3
Aluminum	12.8
Copper	9.4
Gage blocks	6.36 to 7.0

Handle blocks only when they must be moved and hold them between the tips of your fingers so that the area of contact is small. Hold them for short periods of time only.

NOTE

Avoid conducting body heat into the block by careless handling. Body heat may raise the temperature of the block, causing a serious error in a measurement, particularly if a long stack of blocks is being handled.

When using gage blocks consider the source of error resulting from temperature. Metals other than iron and steel (such as aluminum) have a much different coefficient of linear expansion which will result in a difference between the room temperature measurement and the standard measuring temperature measurement. Careless handling of gage blocks may produce an error of several millionths of an inch and this error increases proportionally with the dimension of the block.

The temperature of the work may be either lower or higher than the room temperature as a result of a machining operation and this difference may be sufficient to cause a sizable error.

Theoretically, the measuring pressure should increase proportionally with the area of contact. For practical purposes, it is better to use a standard measuring pressure. The most commonly used pressure is 1/2 to 2 pounds.

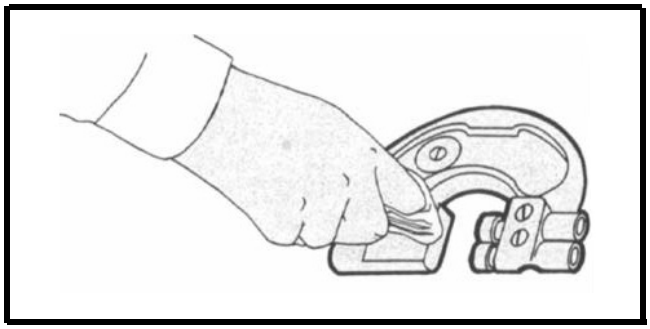
Gage blocks are used in the layout and in checking the accuracy of tools, dies, and fixtures. They are also used in machine setups and in checking parts in process of manufacture and finished parts.

Gage blocks are commonly used in setting adjustable instruments and indicating gages and verifying inspection gages. Gage blocks are used to verify the accuracy and wear of ring and snap gages and many other special-purpose gages. The classification of blocks depends largely on the accuracy required. Typical classification is shown on the following page.

FACTORSTO CONSIDER WHEN USING GAGE BLOCKS - Continued

C/ass	*Work*	*Error range millionths of an inch*
I	Verifying gages, setting instruments, and tool inspection.	5 to 20
II	Layout of jigs, fixtures and dies, setting instruments, and tool inspection.	20 to 40
III	Setup of grinding, milling and drill machines, and parts inspection.	40 to 100

CARE OF RING AND SNAPGAGES



1 Always make certain that the surfaces of the parts gaged and the gage itself are kept free from abrasives, dirt, grit, chips, and all foreign matter.

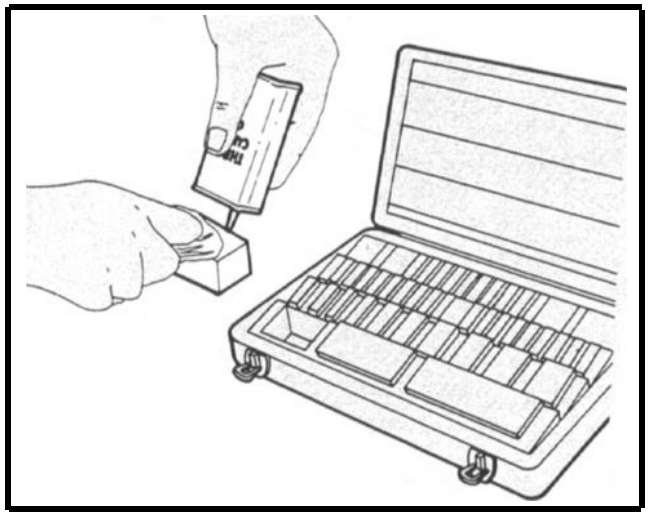
2 Always consider the abrasive action of the part on the gage. Cast iron, steel, and cast aluminum are more abrasive than brass, bronze, and nonmetals such as plastics. Use particular care when gaging cast iron, steel, and cast aluminum.

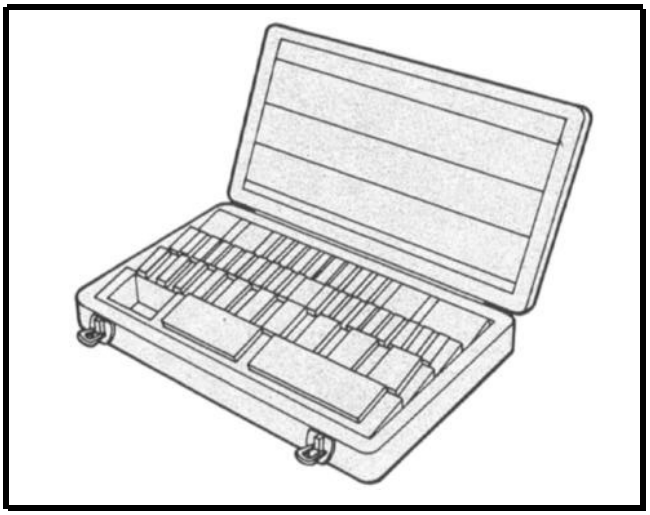
3 When gages are stored, arrange them neatly in a drawer or case so that they do not contact other tools or each other.

4 Always hold the gages in your hands when checking. Never clamp them in a vise.

5 At frequent intervals, check all gages for accuracy and wear with gage blocks or master gages.

CARE OF GAGE BLOCKS





1. Observe particular care when using gage blocks to measure hardened work. The danger of scratching is increased when the work is as hard as the block, or harder.
2. Never touch the measuring surfaces of blocks any more than necessary. The moisture from your hands contains an acid which, if not removed, will eventually. stain the blocks.
3. Before using blocks, ensure there is no grease, oil, dirt, or any foreign substances on block.
4. Every time a set of blocks is used, all the blocks which have been cleaned for use must be covered with a film of acid-free oil, such as boiled petrolatum, before they are put away. Wipe them with an oiled chamois as you return the blocks to their places in the case.